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East European Reliance on Technology Imports from the West

Steven W. Popper

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This report, an overview of current East European reliance on technlogy imports from the West, assesses the importance to the East Europeans of these imports. The study develops a measure to provide a relative scale of reliance on Western imports for a sample of high-technology commodities for each of the six East European members of the Council for Mutual Economic Assistance (CMEA), the Soviet Union, and Yugoslavia, from 1980-1984. The analysis indicates that (1) there is a great diversity in the degree of reliance on Western imports between countries and across commodities; (2) the measure of Western import reliance generally declined during this period; (3) the countries of Eastern Europe tend to rely on the West more for the less compressible higher-technology goods included in the sample than for general machinery imports, and they rely more on the CMEA than on the Soviet Union; and (4) U.S. ability to unilaterally affect Western technology deliveries to Eastern Europe is limited.

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East European Reliance on Technology Imports from the West

Steven W. Popper

August 1988

Prepared for the
Office of the Under Secretary of Defense
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PREFACE

This report presents an initial effort to assess the reliance individual non-Soviet Warsaw Pact (NSWP) countries place on high-technology imports from the West. The study, performed under RAND's Warsaw Pact Cohesion project, was undertaken to provide insights into the contribution of Western technology to East European growth and to examine how the need for technological development will affect the relations of the NSWP countries with the Soviet Union and with the West.

The results should be of interest both to analysts of East/West technology trade and to those charged with formulating policies affecting these flows. This research was sponsored by the Under Secretary of Defense for Policy under RAND's National Defense Research Institute, a Federally Funded Research and Development Center supported by the Office of the Secretary of Defense.

SUMMARY

Economic growth in Eastern Europe depends, in part, on a continuing transformation of the technological base of industry. As a practical matter, the necessary technology inputs must come from sources indigenous to the Council for Mutual Economic Assistance (CMEA) or from the West. This adds a complicating political dimension to the process of technology acquisition that Western policymakers should consider.

This report provides an initial overview of current East European reliance on technology imports from the West and assesses the importance to the East Europeans of these imports. The study develops a measure to provide a relative scale of reliance on Western imports for a sample of high-technology commodities. The measure is calculated for each of the six East European members of CMEA as well as for the Soviet Union and Yugoslavia over the period 1980–1984.

The analysis indicates that **there is great diversity in the degree of reliance on Western imports between countries and across commodities.** There is generally higher reliance on non-export-controlled goods such as centrifuges and filtration apparatus and less on controlled commodities such as microcircuitry and automated data processing equipment, but there is considerable variation between countries. All of the East European countries studied were found to have generally high import reliance measures for the important import category of machine tools. Any policies relating to Western technology exports to Eastern Europe must take these national and particular differences into account.

The measures of Western import reliance generally declined during 1980–1984. Several factors could explain this. First, the decline could be attributable to hard currency current-account problems. Second, it may be that the CMEA was becoming more self-reliant, better able to substitute for Western technology imports. Third, after absorbing what appeared to be the lessons of the 1970s, the nature of technology transfer from West to East changed, and the East Europeans began placing more emphasis on mechanisms other than direct purchase.

The case of Bulgaria suggests that the last two phenomena were not preponderant. Bulgaria moved from the lowest overall reliance level in 1980 to the highest by 1984. The data indicate that in spite of any material assistance Bulgaria might have been able to draw upon from CMEA sources or from other avenues of technology transfer, its drive

to upgrade industry has required increased reliance upon Western imports.

Eastern Europe is generally more reliant on the developed West for high-technology goods than for other types of machinery and equipment. This has held constant during the five-year period and suggests that trade with the West has become more focused on such goods. Two inferences may be drawn: First, in the presence of hard currency constraints, the import strategies of Eastern Europe have given priority to capital goods that could not be obtained within the CMEA and that were necessary for sustaining current investment plans. In this case, the data suggest that the higher the technological level of the machinery, the less elastic is the demand with respect to the hard currency budget constraint. The second inference is that the nondecreasing trend of the ratio could be ascribed to an increased ability on the part of the CMEA to satisfy the lower end of the bloc's technology requirements, while not affecting the continuing need for Western imports of higher-end commodities. Western technology imports may be necessary to fill gaps in CMEA supply or to provide crucial components necessary to increase the effectiveness of less advanced CMEA equipment.

For most countries, the inclusion of Soviet export data in the analysis results in an increase in the difference between high-technology and general machinery trade patterns. The inference is that **the countries of Eastern Europe tend to rely on the West more for the higher-technology goods included in the sample than for general machinery imports, and they rely more on the European CMEA than on the Soviet Union.**

The ability of the United States to unilaterally affect Western technology deliveries to Eastern Europe is limited. There is a major difference between the role played by the United States and that played by several of its major allies in supplying high-technology goods to the CMEA. In 1984, U.S. exports of technology goods to the CMEA were negligible as a proportion of total U.S. technology exports. In contrast, shipments by West European countries to the CMEA accounted for a significant share of total exports in several categories. In no case did the United States contribute more than 5 percent of the Western technology-sample imports to any CMEA country in 1984. The average was about half that. These figures suggest that U.S. action to control direct technology exports can be effective only as part of a multilateral effort.

There are several problems in translating technology import reliance into a meaningful measure of dependence on foreign technology. To

investigate some of these difficulties, the case of machine tool imports in Hungary was examined in more detail.

Hungarian machine-tool import data corroborate earlier measures that indicate the importance of imports from the West. Approximately one of every eight machine tools installed in Hungary in 1983 was imported from the developed West. The more restricted the definition of high technology, the greater this reliance. Imports accounted for 49 percent of all numerically controlled (NC) machine-tool investment in 1983, a year of general retrenchment of investment, and more than 85 percent of these imports came from the West.

It appears that machine tools from domestic or CMEA sources could not easily substitute for those imported from the West. Hungary and the CMEA may concentrate on producing relatively few machine types to take care of the bulk of machining jobs, and Western machines may be acquired along a wider range to fill the gaps in the CMEA output assortment. If this is indeed the case, it indicates that potential substitutes for some fraction of the NC machine tools imported from the West do not presently exist within the CMEA. It would be incorrect to say that these imports are indispensable, however; the willingness to bear the attendant costs of denial must also be considered.

ACKNOWLEDGMENTS

This report has benefited considerably from the insightful comments of RAND colleagues Abraham S. Becker, Keith Crane, and David Kassing. Any errors that remain are, of course, the sole responsibility of the author.

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I. INTRODUCTION

EASTERN EUROPE, TECHNOLOGY, AND THE WEST

Since World War II, a continuing difference between the technological levels of the developed West and Eastern Europe has led to a net transfer of technology from West to East. This flow increased greatly during the 1970s. Exports of manufactured goods from the developed West to the countries of the Council for Mutual Economic Assistance (CMEA)[1] increased from $5 billion (in current prices) in 1970 to nearly $30 billion in 1980 (Lenz and Stiltner, 1985). The absolute level of trade in technologically advanced machinery increased proportionately.

The attractiveness of technology transfer for the European CMEA members is inherent in its definition, i.e., "any process whereby the productivity of resources in one country can be increased by the transmission from other countries of information or of products and processes embodying that information" (Hanson, 1981). The development policies of several CMEA countries were predicated on an implicit belief that a large, one-time infusion of foreign technology would be sufficient to permanently improve the technological level of industry to the point where more efficient use could be made of inputs, thus ensuring an acceleration of economic growth. The resulting renewal of economic vigor was expected to eventually cause technology reliance to decline.

The optimistic development and import plans of the 1970s, however, gave way to disillusionment and retrenchment in the 1980s.[2] The financial ability to support expensive imports at previous levels was undercut in most cases by debt and poor export performance. Further, the imported technology by and large did not produce the effect wished by those who expected significant transformation. Considerable problems were encountered with absorption and with making full use of the imported capital. Most important, the overall technology gap did not disappear. In many of the most crucial sectors, it held constant or even widened.

The immediate prospects for most of Eastern Europe are not auspicious. All six nations of the region face the need to modernize industry

[1]In this report, the term *CMEA* is used in a restricted sense, referring only to the Soviet Union and the six East European member states that are also members of the Warsaw Pact.

[2]In 1983, CMEA imports of Western manufactured goods totaled $24.6 billion in current prices.

and reclaim declining shares of hard currency export markets through increased competitiveness. There is also a general need to resume more rapid economic growth, while not concurrently increasing the demand for material inputs. At the same time, the states of Eastern Europe need to legitimize socialism by increasing the satisfaction of consumers who are becoming increasingly sophisticated in their knowledge of Western living standards, to avoid permanent dependence on the West for advanced technology, and, in concert with the Soviet Union, to maintain their current military posture vis-à-vis the West. The resources for meeting all these challenges simultaneously have come less readily to hand in the 1980s than in previous decades.

The one *deus ex machina* that might balance all accounts without slighting any of these major tasks would be an increase in production efficiency through fundamental changes in the technology base. But the technique for upgrading the level of technology in the CMEA has not been determined definitively, nor has the potential role of the West in providing the means to do so. This is likely to remain an important policy matter for the CMEA in view of the wide range of East European problems and interests, and it will be a crucial area of contact with the West going into the 1990s.

WHAT WE MEAN BY HIGH TECHNOLOGY

The phrase *high technology* requires some definition. All manufactured goods, by their nature, result from applying a technology, or a set of technologies, to a collection of raw-material inputs. To merely speak of *technology* goods would be too broad. At the same time, it is not easy to give the term *high technology* a precise meaning. In this study, the adjective *high* is used to indicate a set of manufactured capital goods that are produced to higher tolerances than is usual for the bulk of manufactured goods or that confer an ability to do things other goods of that class do not permit. The latter distinction provides the motivation for controls on high-technology exports that might have an effect on national security. Not coincidentally, an effective means of coordinating an extensive range of complex research and development activities is usually required for such goods to be designed and produced economically.

No simple definition can nearly indicate where the line of "high" technology is crossed. For the purpose of this study, the specific commodities that will be grouped under this rubric are a subset of those identified as high-technology commodities by the U.S. Department of Commerce (Lenz and Stiltner, 1985).

This group of high-technology commodities is of interest for several reasons, including the chronic difficulties experienced by CMEA countries in achieving adequate levels of production of some advanced machine types and the emphasis that East European countries have placed on access to imports from the West. Finally, as alluded to above, Western countries are sensitive to the transfer of certain technologies on security grounds. This is not to discount the possibility that other classes of East European machinery imports exist for which the gains from trade are substantial and the degree of reliance high. Given the distorted price systems and the institutions of resource-allocation decisionmaking present in these countries, there might even be cases of high reliance on imports for which the relative costs of domestic production would be much lower.[3] However, this study is concerned only with high-technology commodities, as defined above, for which there is reason to believe the CMEA countries are at a comparative disadvantage as a trading bloc.

PURPOSE AND SCOPE OF THIS REPORT

All the Western countries participating in the Coordinating Committee on Export Controls (COCOM) implicitly accept the need for a policy related to technology exports, as witnessed by the controls they exercise over certain commodity groups. The fact that Eastern Europe depends to a degree on the West as a source for inputs of high-technology commodities and technical expertise has on occasion given rise to the suggestion that technology transfer might be employed as a policy tool by the West to influence East European behavior in other areas. Such policies might be framed in a somewhat passive form, with technology trade being encouraged to demonstrate and establish a commonality of interests and interdependence between Non-Soviet Warsaw Pact (NSWP) states and the West. More active approaches might involve denying or modulating technology flows as a means of exerting leverage. Technology transfer would thereby become a tool to influence the character of East-West relations—and perhaps relations within the Soviet bloc as well by raising doubts about where individual NSWP states may calculate that their best interests lie.

Any policy predicated upon active control of technology flows as a means to other ends would be complex in itself and would require careful orchestration within a broad set of other policy interests. A *sine qua non* for assessing the reasonableness of such policies, even before addressing the questions of implementation, purpose, and likely effect,

[3]I am indebted to my colleague Abe Becker for clearly elucidating this distinction.

would be to determine the extent to which the economies of individual East European countries depend on technology inputs from the West. This study provides an initial overview of NSWP reliance on Western technology. Its scope is quite limited, focusing on open trade in a selected subset of capital goods that are identified as embodying high-technology characteristics. Transfer through licensing, joint production schemes, scientific exchanges, literature screening, and other legal avenues, as well as covert means of technology transfer, are excluded. Thus, this report is only a preliminary step toward answering the larger question of actual technology dependence. It explores the methodology that might be employed in a more extensive effort and provides a first approximation, a general sense of the bounds within which a discussion of policy choices must be framed.

OUTLINE OF THE REPORT

Section II illustrates one approach to quantifying NSWP dependence on technology inputs from the West. Reliance on Western imports by individual East European countries is measured for several disaggregated high-technology commodity groups. The focus is on determining the import groups for which reliance is the greatest, assessing differences in reliance between countries, and examining the overall change in reliance between 1980 and 1984.

Section III uses the information generated in Section II to provide a measure of overall reliance for each NSWP country by aggregating over the group of commodities discussed. This measure is then compared with a similar measure for reliance on machinery types that fall outside the selected group of high-technology commodities to determine if reliance on these commodities is greater than on the general category of machinery imports. The section concludes with a discussion of the supply side of the equation, the relative importance of these commodities to Western countries as exports.

Section IV addresses the relative importance of imports in domestic absorption (i.e., domestic production net of exports, plus imports). A brief case study, the importation of machine tools in Hungary, is presented to determine the degree of Hungarian industry's dependence on the import of Western machine-tool types, particularly higher-technology, numerically controlled (NC) tools. This use of additional data sources provides a check on the relation between the import reliance measures developed earlier and the actual flow of imports to Eastern Europe. Similar work would be necessary for each commodity group and for other countries to develop a fuller picture of what import reliance portends for dependence.

II. EAST EUROPEAN RELIANCE ON INDIVIDUAL COMMODITIES

THE CONCEPTS OF DEPENDENCE AND RELIANCE

It is difficult to frame an operational definition of import dependence that permits unequivocal statements about the relationships that actually exist between trading nations. This is partly due to the complex combination of economic factors that must be considered in determining the benefit any nation derives from trade. Such factors include the existence, availability, and closeness of substitutes; comparative advantages and opportunity costs; the likely effects on individual economic sectors of the imports themselves or of the failure to import; and the complex problems of convertibility and exchange rates that are peculiar to East-West trade. Economically, the concept of dependence in the aggregate is based upon myriad micro-level dependencies whose potential for damaging the economy in the case of denial of specific commodities must be assessed in relation to each other as well as individually.

It is clear, however, that the colloquial use of the term *dependence* often goes beyond its narrow economic sense; the meaning it conveys is also inherently a political one. Even if it can be shown unequivocally that a specific policy of denial will lead to costs or reduced efficiency being imposed upon an erstwhile trading partner, at what level can such costs be said to be unacceptable? Clearly, the answer depends on the choices made by the target's political leadership. If the response is to bear the costs and alter relations in the domestic economy rather than modify other behavior in the face of an embargo, it is difficult to say that a nation is dependent on the severed trade tie in the simplest sense of the word. There are few commodities or bilateral trade relations for which a policy of denial by one party will lead to a visible collapse of, or clearly unacceptable loss to, the target of the embargo.

This complicated relationship can be made more meaningful by making a clear distinction between the concepts of dependence and vulnerability (Becker, 1984). Dependence can be measured in terms of economic costs in the case of denial, whereas vulnerability is a question of political will, the decision over whether or not to resist pressure and assume the attendant costs. In light of this, Becker concludes that Soviet vulnerability to policies of denial is less than is implied by statistics on Soviet trade participation. This is due in great measure to

the Soviet Union's vast natural resources and to the existence of a more or less satisfactory assortment of domestically produced industrial goods.

Other CMEA states, however, do not have the same advantages as the Soviet Union. Also, both Eastern Europe and the Soviet Union may have less room for maneuver due to low elasticities of substitution and greater costs attendant on denial of some classes of goods. Higher-technology goods may fall into this category. Does this imply greater dependence and perhaps even greater vulnerability? Any analysis of dependence on such commodities brings with it all of the complexities previously noted as well as the difficult problem of deciding at the micro level what the effects of different capital types are in practice. For example, are net costs reduced through technology import by avoiding the necessity of redundant R&D processes, or are they raised due to increased and continuing reliance on imported capital and components that may require considerable outlay of hard currency? Is efficiency increased by adding a leavening of high-technology Western capital to enterprise shops equipped primarily with machinery of CMEA origin, or is it reduced, on balance, because of problems of absorption and increased difficulties of managing the integration of machinery at differing levels of technology?

This study does not confront the complexities of the larger question of dependence on the West for higher-technology goods. It is limited to an initial determination of the revealed reliance on Western imports by individual East European countries for specific categories of higher-technology goods. While it does not deal directly with import dependence, it provides an important first step by estimating the share of Western imports in the total imports of important commodity groups.

A MEASURE OF RELIANCE ON IMPORTS FROM THE WEST

Measures of reliance on imports from the West are developed below for several commodity groups for each of the six East European members of the CMEA. These will be referred to as *Western import reliance measures.* Similar measures are calculated for the Soviet Union and for Yugoslavia. The Soviet data provide a scale for comparison in that they most likely represent the extreme case of export control by the West. Yugoslavia resembles the East European CMEA countries in that it has a similar economic system, level of industrial development, and foreign debt burden, but it has only observer status

in the CMEA, so it is not nearly as tightly bound into standing trade agreements with the CMEA countries. Most important for the present purpose, Yugoslavia is not subject to formal export restrictions under COCOM agreements. Therefore, Yugoslavia roughly represents the other theoretical extreme of reliance on the West for high-technology capital goods.

The import reliance measure is calculated by aggregating the total imports from developed Western countries[1] for each disaggregate commodity group and dividing this value by the total for all imports in this category from both the West and the CMEA. The measure is stated as a ratio, with 1.00 the theoretical maximum, i.e., all imports in the category come from the West, and 0.00 the minimum, i.e., no imports come from the West. All data are derived from statistics compiled annually by the United Nations Economic Commission for Europe (UNECE). The analysis focuses on the time period 1980 to 1984, because these are the years for which the most recent UNECE figures are available. Since Soviet data are available only for 1980 and 1983, the basic import reliance measure has been calculated for each year excluding Soviet exports in the denominators. For those two years, a second measure, including Soviet data, is reported.

The Appendix presents a more detailed discussion of the shortcomings and strengths of this measure. However, three points should be made here. First, the measure was constructed by aggregating mirror export statistics rather than by relying on each CMEA country's import data. This provides more continuity to the reporting across time. It also reduces somewhat the possible effects of idiosyncratic reporting practices on comparisons across countries, thereby strengthening the assumption of *ceteris paribus*. This method also allows import reliance measures to be constructed for the German Democratic Republic (GDR) and Rumania, which is not possible using only the official publications of those countries.

Second, the method is intended to provide a means for comparison and ordinal ranking. It should not be interpreted as a precise measure of the *absolute* levels of import reliance—there are too many compromises and simplifications in the data, not the least being that the denominator cannot include imports from all sources.[2] However, these figures do constitute relative measures that can be used to compare different degrees of reliance across countries and over time. Acknowledging that there are variations in accounting practices as well as

[1]This procedure is detailed in the Appendix, and the commodity groups are also discussed.

[2]See the note on country data in the Appendix.

valuation problems, an assumption of *ceteris paribus* permits the interpretation that a country with an import reliance measure of 0.43 is more reliant than one with a measure of 0.19, and a decline from 0.35 in one year to 0.17 the next indicates a decline in reliance over time.

Third, the statistic measures reliance on the West as a source of imports. It says nothing about reliance upon imports in general. A high relative import reliance implies that much of what is imported in a given category comes from the West, not necessarily that there is a great absolute dependence on imports of that commodity. A high reliance on imports from the West for a particular commodity may take on a new meaning if total imports account for only a small fraction of total domestic demand for that good. This is where more detailed knowledge is essential to understanding dependence: What is the actual role played by the imported technology from the West? Even when absolute import levels are not very significant and reductions in Western imports may not appear large in terms of total consumption by domestic industry, bottlenecks may cause greatly magnified effects. This was the experience of several East European countries with administrative import restrictions during the 1980s.

FINDINGS BY COMMODITY GROUP

All of the import reliance measures in the following discussion refer to the value of exports from the West to a given country divided by the total of these exports and exports to the country from the other members of the East European CMEA (with the exception of Rumania). For 1980 and 1983, data were also available on some categories of Soviet exports to Eastern Europe. The import reliance measures incorporating Soviet deliveries are given in brackets for those years.

Centrifuges, Filtration Apparatus, Pumps for Nonliquids, Compressors

The data for exports in Standard International Trade Classification (SITC) 743, which include filtration apparatus, centrifuges, compressors, and pumps for nonliquids, are reported in Table 2.1. These goods have generally high import reliance measures relative to other goods in the sample. They are included because they often require careful machining to precise tolerances, yet are not subject to severe export controls. Yugoslavian reliance on Western deliveries in total imports is almost 1.00. The measure for Hungary is also high and increases from

Table 2.1

WESTERN IMPORT RELIANCE MEASURES FOR CENTRIFUGES, PURIFICATION AND FILTRATION APPARATUS, NONLIQUID PUMPS, AND COMPRESSORS (SITC 743)[a]

Country	1980	1980[b]	1981	1982	1983	1983[b]	1984
Yugoslavia	0.99	[0.99]	0.99	0.93	0.98	[0.95]	0.99
Bulgaria	0.50	[0.41]	0.55	0.78	0.83	[0.71]	0.75
Czechoslovakia	0.60	[0.60]	0.61	0.64	0.62	[0.55]	0.64
GDR	0.35	[0.35]	0.32	0.75	0.64	[0.61]	0.49
Hungary	0.77	[0.74]	0.80	0.87	0.88	[0.84]	0.89
Poland	0.76	[0.72]	0.49	0.64	0.63	[0.60]	0.72
Rumania	0.74	[0.68]	0.64	0.38	0.38	[0.28]	0.39
USSR	0.63	[0.63]	0.46	0.66	0.73	[0.73]	0.45

SOURCE: UNECE, various years.

[a]Does not include Rumanian or Soviet exports, or exports from the FRG to the GDR.

[b]Includes Soviet exports.

1980 to 1984, while that for Bulgaria shows the greatest increase, from 0.50 [0.41] to 0.75, achieving an even greater measure in the intervening years. The measure for the GDR rose over the period, while Czechoslovakia's showed little change, remaining in the range of 0.60. Among the six East European CMEA countries, only Poland and Rumania showed a decline during the period, and the overall Polish decline was nominal, with a dip in 1981. Rumanian reliance fell from 0.74 [0.68] in 1980 to 0.38 in 1982 and leveled off at that point. Rumania's 1984 import reliance measure for these goods is still higher than its reliance measure for any other commodity group in the technology sample.

The evidence suggests that this category contains high-technology goods that either are not produced in sufficient variety in the CMEA or are of higher quality in the West. In the absence of export controls, current reliance on this technology is comparatively high. Thus, this group provides a good test case for examining some of the recent trends in science and technology relations between CMEA states. The Comprehensive Program in Science and Technology, which is currently being implemented, is open to several interpretations. Is the program intended to raise the indigenous technological base upon which the CMEA states rely, as is reported by its proponents, or will it concentrate on technologies currently embargoed by Western technology export controls? One test may be to observe the extent to which resources are devoted to developing indigenous substitutes for high-quality technical commodities that are readily available from the West.

The difference between the import reliance measure for Yugoslavia and that for the CMEA in general (ranging from 0.10 to 0.45) may in this case be attributable more to the ongoing trade patterns dictated by CMEA institutions (and a concomitant orientation by Yugoslavia toward Western markets) than to export differentiation by Western nations. The inclusion of Soviet deliveries in the data for 1980 and 1983 made a significant difference only in the import substitution behavior of Bulgaria and in financially strained Rumania in 1983.

Metal-Working Machine Tools

SITC 736 covers metal-working machine tools, further disaggregated into 736.1, metal-cutting, and 736.2, metal-forming, machine tools. Both categories include traditional, manually operated and controlled varieties as well as higher-technology NC, computer NC, and direct NC machines. Many NC machine tools are on the export control lists of the West, either because of their sophisticated microelectronics or the characteristics of the tools themselves, e.g, multi-axis tooling capability. The trade data do not distinguish among these categories, even at the five-digit SITC level. The simplest hypothesis is that for most of Eastern Europe the tendency would be to import the less-complex machines from CMEA partners rather than the West because of the difference in cost. Only more-advanced, higher-quality tools that are not readily available from CMEA partners are worth the expenditure of hard currency necessary to import them from the West.

Machine tools are an interesting case, for two reasons. First, they are the archetypal producers' good. They are the machines that make other machines and are an essential engine for driving economic growth. The ability to produce high-technology machine tools has been a prime desideratum of the CMEA, and a great deal has been invested in attempting to achieve this ability. NC machine tools integrated into flexible manufacturing systems with the addition of robotics are a major thrust of CMEA's Comprehensive Program in Science and Technology and the subject of the first multilateral joint venture, INTERROBOT. Of the Program's five main areas, digitalized machine-tool technology appears to have received the most attention initially. This is quite understandable. Investments to increase the capacity of the Soviet Union to produce higher-quality machine tools in greater quantities have been made the cornerstone of the Gorbachev investment program. The Soviets are also eager to receive machine tools from East European manufacturers that come closer to world standards of technical quality.

Machine tools are also interesting because they form the single largest category of Western high-technology imports into the CMEA, by value. In 1983, they accounted for 2.3 percent of total Western exports to Socialist countries and 20 percent of all high-technology exports, as defined by the U.S. Department of Commerce (Lenz and Stiltner, 1985).

The data for machine tools are shown in Table 2.2. The import reliance measures for machine tools are relatively high, but unlike those for centrifuges and filtration apparatus, they decline between 1980 and 1984. During this period, the measure for Yugoslavia, again the country with the largest import reliance, declined only slightly, from 0.79 [0.75] to 0.73. Like most of the East European CMEA, Yugoslavia suffered from balance-of-payments difficulties during this period, more severely than most. Although they are not affected by COCOM restrictions, given their trading relationship with the CMEA, the Yugoslavs would probably prefer to be able to import from the CMEA the goods that are not available domestically. Therefore, many of the Western machine tools Yugoslavia imports may be advanced types that are not available from the CMEA.

However, it cannot be assumed that the observed import reliance stems solely from a difference in technological level. There are practical difficulties in guaranteeing regular shipments from CMEA countries of goods that are subject to chronic excess domestic demand.[3] The mechanism of trade within the CMEA also compounds this with problems of timely delivery, quality control, and service support. These might lead to some purchases of Western machine tools even though satisfactory substitutes are theoretically available from CMEA countries. Nevertheless, the fact remains that the Yugoslav reliance measures in this category are considerably higher than those for any of the other countries under discussion. A portion of the difference between the Yugoslav import reliance measure and that of the CMEA countries must be ascribed to Yugoslavia's ability to import machine tools of a technological quality that would also be attractive to East European importers in the absence of export controls by the West.

Of the eight countries in the sample, only Bulgaria showed a marked increase in the import reliance measure for machine tools, starting from the lowest level in the CMEA in 1980 and achieving the highest in 1984. The apogee was reached in 1983, due, in part, to a strategy emphasizing greater growth in machinery and equipment investment than in total investment, and the absence of the balance-of-payments problem that affected other CMEA countries. Hard currency loans

[3]It is not clear, however, that all types of machine tools would necessarily fall into this category.

Table 2.2

WESTERN IMPORT RELIANCE MEASURES FOR METAL-WORKING MACHINE TOOLS (SITC 736)[a]

Country	1980	1980[b]	1981	1982	1983	1983[b]	1984
Yugoslavia	0.79	[0.75]	0.75	0.73	0.70	[0.63]	0.73
Bulgaria	0.25	[0.18]	0.41	0.42	0.54	[0.43]	0.49
Czechoslovakia	0.50	[0.38]	0.39	0.40	0.39	[0.31]	0.42
GDR	0.39	[0.30]	0.43	0.39	0.39	[0.30]	0.19
Hungary	0.52	[0.45]	0.45	0.35	0.42	[0.36]	0.40
Poland	0.64	[0.46]	0.67	0.57	0.32	[0.24]	0.31
Rumania	0.50	[0.42]	0.30	0.10	0.22	[0.15]	0.10
USSR	0.55	[0.55]	0.47	0.40	0.41	[0.41]	0.32

SOURCE: UNECE, various years.

[a]Does not include Rumanian or Soviet exports, or exports from the FRG to the GDR.

[b]Includes Soviet exports.

were available, especially from Japanese banks that were eager to increase their presence in Bulgaria. Poland began in 1980 with the highest import reliance measure, 0.64 [0.46], but fell to 0.32 [0.24] by 1983 and leveled off. This was almost exactly the Soviet measure for machine tools in 1984, down from 0.55 in 1980.

These figures suggest that there may be a relatively high level of fundamental reliance on Western machine-tool imports, on the order of 0.30, necessary to maintain reasonable and prudent levels of basic growth in CMEA economies. While this is by no means certain, only two countries fell below this level during the period studied, the GDR and Rumania. The GDR's 1984 measure of 0.19 is suspect because of the exclusion of imports from West Germany and because it represents a sharp dip from the steady 0.39 [0.30] registered in 1980 through 1983. The downturn might be explained by East Germany's hard currency liquidity squeeze, which led to greater use of the special bilateral clearing arrangement with West Germany than of conventional commercial relations with the rest of the West. Rumania's decline from 0.50 [0.42] to 0.10 can be explained by the fact that Rumanian economic and trade policy at the time resembled less a case of trimming the sails than of scuttling the ship.

A result of some interest in the case of Czechoslovakia and several of the more technically advanced East European countries is the relatively lower attractiveness of Soviet machine tools inferred from these data. The availability of Soviet export data for 1980 and 1983 makes possible the calculation of two import reliance measures, the standard

as well as one incorporating Soviet deliveries. The difference between the import reliance measures calculated both with and without these data may be seen in Table 2.2 above. Table 2.3 shows the percentage by which Soviet deliveries reduced the standard import reliance measures in 1980 and 1983.

In 1983, when matters of hard currency cost and relative price would presumably be most dominant, Western import reliance measures generally fell, but the relative differences between these measures with and without Soviet exports actually narrowed for several countries when compared to the figures for 1980. In other words, Czechoslovakia, Bulgaria, and even Poland concentrated on filling the machine-tool import gap with deliveries from the non-Soviet CMEA in preference to increasing Soviet deliveries. The ratios of the two import reliance measures for 1980 and 1983 remained more or less unchanged for the GDR and Hungary; only Yugoslavia, marginally, and Rumania, significantly, relied on more Soviet imports relative to the total. The implication is that the rest of the CMEA countries view Soviet machine-tool deliveries less favorably, or rely upon them less fully, than those from other CMEA states. If this is the case, the Soviet Union may have a greater need than many CMEA countries for imports of machine tools of higher technical quality. However, further study would be required to determine whether the observed effect is the result of an inability to produce acceptably sophisticated machine tools or a reluctance to export the machines that are produced.

It is not possible with these data to assess what portion of the decline in import reliance measures in the CMEA may be due to

Table 2.3

CHANGE IN STANDARD IMPORT RELIANCE MEASURES FOR METAL-WORKING MACHINE TOOLS RESULTING FROM SOVIET DELIVERIES

(Percentage)

Country	1980	1983	Change
Yugoslavia	5.0	10.0	5.0
Bulgaria	28.8	20.8	-8.0
Czechoslovakia	24.2	18.4	-5.8
GDR	23.4	23.3	-0.1
Hungary	13.9	15.4	1.5
Poland	27.9	23.0	-4.9
Rumania	16.5	33.6	17.1

SOURCE: UNECE, various years.

increased self-sufficiency in machine-tool production, which, no doubt, plays some part. However, a cursory examination of other data sources suggests that the volume of Western machine-tool exports to most of the CMEA increased in 1985 and 1986.[4] The 1980–1984 decline is more likely attributable to economic difficulties than to a dramatic change in the CMEA's ability to substitute for imports.

The import reliance measures for the disaggregate groups of metal-cutting and metal-forming machine tools are given in Tables 2.4 and 2.5. These data are less reliable, since several nations do not report exports in this category below the three-digit level. In general, the decline from 1980 to 1984 was more precipitate in the case of metal-forming machine tools.

Automatic Data Processing Equipment

SITC 752 includes computers, their component central processing units, peripheral devices, disk drives, and other data storage apparatus. This category can reasonably be said to include high-technology commodities, since the current version of the SITC, Revision 2, separates less-advanced equipment such as general office machines and calculating machines into other categories. SITC 752 goods are among the most stringently controlled by COCOM and other export control authorities, as is clear from the import reliance measures given in Table 2.6.

Yugoslavia, not on the COCOM proscribed list, had high but falling import reliance measures.[5] The nadir occurred in 1983, 0.78 [0.78]. Again, the clearest explanation for the decline is severe hard currency balance-of-payments problems. The highest import reliance measure among the other countries was Rumania's 0.55 in 1980, which fell to 0.04 [0.04] in 1983 and 0.10 in 1984. Rumania was not an active participant in the cooperative CMEA computer program and relied as much as possible on Western contacts, including, but not limited to, imports. Rumania also has joint ventures with Western microelectronics manufacturers. It has received preferential treatment in many areas of export control, but many of its requests for exception in microelectronics have been denied. The other CMEA nations that received generally favorable treatment from the West, particularly those granted most-favored nation (MFN) status by the United States, also had the highest import reliance measures. Poland fell from 0.46 to 0.10 [0.08]

[4]E.g., exports of nontransportation machinery and equipment from the European Economic Community (EEC) to the East European CMEA countries increased 27 percent in 1985 over the preceding year (Wharton, 1986).

[5]The Soviet Union did not report its exports in this category in 1980.

Table 2.4

WESTERN IMPORT RELIANCE MEASURES FOR METAL-CUTTING MACHINE TOOLS (SITC 736.1)[a]

Country	1980	1981	1982	1983	1984
Yugoslavia	0.88	0.84	0.75	0.72	0.77
Bulgaria	0.35	0.63	0.47	0.61	0.61
Czechoslovakia	0.52	0.40	0.44	0.42	0.44
GDR	0.73	0.72	0.33	0.35	0.19
Hungary	0.71	0.55	0.27	0.48	0.34
Poland	0.74	0.76	0.55	0.28	0.28
Rumania	0.46	0.32	0.06	0.22	0.10
USSR	0.69	0.56	0.45	0.47	0.36

SOURCE: UNECE, various years.

[a]Does not include Rumanian or Soviet exports, or exports from the FRG to the GDR.

Table 2.5

WESTERN IMPORT RELIANCE MEASURES FOR METAL-FORMING MACHINE TOOLS (SITC 736.2)[a]

Country	1980	1981	1982	1983	1984
Yugoslavia	0.95	0.90	0.70	0.90	0.80
Bulgaria	0.58	0.80	0.60	0.72	0.56
Czechoslovakia	0.68	0.66	0.50	0.47	0.47
GDR	0.83	0.75	0.66	0.69	0.25
Hungary	0.73	0.80	0.43	0.27	0.45
Poland	0.62	0.92	0.63	0.30	0.17
Rumania	0.77	0.60	0.12	0.11	0.01
USSR	0.52	0.30	0.31	0.23	0.27

SOURCE: UNECE, various years.

[a]Does not include Rumanian or Soviet exports, or exports from the FRG to the GDR.

Table 2.6

WESTERN IMPORT RELIANCE MEASURES FOR AUTOMATIC DATA PROCESSING EQUIPMENT (SITC 752)[a]

Country	1980	1981	1982	1983	1983[b]	1984
Yugoslavia	0.99	0.92	0.90	0.78	[0.78]	0.81
Bulgaria	0.17	0.15	0.17	0.14	[0.11]	0.25
Czechoslovakia	0.21	0.13	0.10	0.08	[0.06]	0.06
GDR	0.12	0.11	0.04	0.13	[0.09]	0.03
Hungary	0.36	0.13	0.22	0.15	[0.12]	0.20
Poland	0.46	0.14	0.10	0.10	[0.08]	0.08
Rumania	0.55	0.19	0.15	0.04	[0.04]	0.10
USSR	0.12	0.07	0.04	0.04	[0.04]	0.05

SOURCE: UNECE, various years.

[a]Does not include Rumanian or Soviet exports, or exports from the FRG to the GDR.

[b]Includes Soviet exports.

in 1983 and 0.08 in 1984.[6] Hungary declined from 0.36 to 0.20 during the period, with a dip to 0.15 [0.12] in 1983. None approached the uncontrolled Yugoslav level. Czechoslovakia, a less-favored but nonetheless technologically advanced nation, also declined steadily.

In addition to balance-of-payments problems, there are several alternative explanations for the general decline in import reliance measures for this category of high-technology imports. The three most likely alternatives would be increased reluctance on the part of Western exporters to transfer the specific technology desired by Eastern Europe, success in developing dependable substitutes within the CMEA, and importation from outside the developed West.

The limited data in this study do not permit strong tests of these competing hypotheses. The first hypothesis carries some weight if the gap between Western and CMEA computer technology is growing. A greater CMEA ability to provide for less-advanced types of computers would lead to a decreasing share of imports from the West in the presence of controls of advanced, dual-use technologies. The second hypothesis, voluntary substitution of increasingly adequate CMEA alternatives, cannot be rejected by the import reliance data. It receives some faint substantiation from data on the change in the absolute volume of trade. For all countries except Yugoslavia, the total value of imports of computer equipment from both the West and the CMEA increased between 1980 and 1984. If the totals received from the West

[6]Poland lost its MFN status following the imposition of martial law in December 1981. However, MFN status should not directly affect imports from the United States. Categorization in terms of U.S. Customs restriction lists is more important.

and from the CMEA are considered separately, they show a sharp increase (from 100 to 300 percent) in the value of total CMEA imports for all countries except Bulgaria. However, this result must not be taken as definitive, because there are serious problems of valuation, and more needs to be known about the pricing of data processing machinery within the CMEA. A comparison of trade figures for 1984 with those for 1980 shows mixed results: a gradual decline in total value imported from the West for some countries, and increases for others. Hungary showed an increase of 18.5 percent, and the Soviet Union, 33.6 percent. Bulgaria's import reliance increased by 85.7 percent. Given that little of this traffic originated in the United States and that the dollar appreciated considerably during this period, it is difficult to say with certainty that the general flatness of the slope for the value of Western computer deliveries means that the physical volume of imports from the West was in decline and substitution was occurring.

Bulgaria, a country without serious balance-of-payments problems in the early 1980s, well-integrated into the CMEA computer program, and making a strong effort to automate production in several industrial sectors, showed no great difference between the increase in its imports of computers from the CMEA and the increase in its imports from the West. There is no evidence of a substitution away from Western computers to more CMEA deliveries. In fact, Bulgaria was the only country in the sample that showed an increased Western import reliance measure, from 0.17 in 1980 to 0.25 in 1984. The strongest statement that can be supported by the data is that it is not yet clear that a CMEA country seeking modernization of production can forgo imports of microelectronic equipment from the West and rely solely on CMEA sources.

The third hypothesis, that imports from developed Western countries are being replaced by imports from newly industrializing countries, obviously cannot be dealt with using these measures. But other information suggests that such a movement is occurring. For example, a Peruvian firm has signed a $2.5 million agreement to provide 100 microcomputers to Czechoslovakia each month for three years. The equipment is described as a clone of the IBM-XT microcomputer.[7]

Higher-performance analogs of the COCOM-restricted IBM-AT are also available to Eastern Europe from Taiwan at a fraction of the cost of the original equipment. This illustrates the problem of export control in an area of rapidly changing technology. In the Peruvian case, the exporting company will use imported parts and add 25 percent of

[7] *East-West Fortnightly Bulletin*, November 14, 1986, No. 398, pp. 8–9.

final value in assembly. The provenance of the component parts is uncertain, making the application of U.S. or COCOM export controls impractical. The ability of the CMEA countries to equip themselves with relatively modern microcomputers despite export control provisions may increase with time as computer-parts manufacturing proliferates to less-developed countries.

Communications Equipment

Import reliance in communications technology was examined for SITC categories 764.1, 764.3, and 764.8. These four-digit categories were used to isolate the technologically more advanced goods from the mass of communications equipment imports. The three categories cover telephone and telegraph line equipment; communications transmitting equipment; and radar gear, radiotelephonic receivers, and television cameras. The data provide less-conclusive results for these categories than for some of the preceding ones because these categories are more heterogeneous and more likely to include less technically sophisticated equipment. There is also greater variation between nations in reporting these categories. The latter problem is somewhat mitigated by the approach of compiling import figures from mirror export data. Nevertheless, several East European countries did not report exports of these types of equipment in 1980. Where possible, the values were deduced from other information, but the import reliance measures are biased upwards.

SITC categories 764.1, 764.3, and 764.8 also include a great number of controlled commodities. The import reliance data, given in Tables 2.7, 2.8, and 2.9, would seem to indicate the importance of this effect. Again, there is a gulf between the figures for Yugoslavia, which are generally between 0.80 and 1.00, and those for the CMEA countries. In all three categories, the CMEA country with the most consistently high import reliance measures is Hungary, with Bulgaria, Poland, and Rumania also exhibiting generally high reliance. A comparison of the data for Hungary with those for Bulgaria shows temporal movement in opposite directions. Between 1980 and 1984, Hungary's reliance declined from 0.45 to 0.15 for SITC 764.1, while Bulgaria's increased from 0.05 to 0.60. Similarly, for SITC 764.8, Hungary slipped from 0.60 in 1981 to 0.22 in 1984, while Bulgaria increased from 0.04 to 0.82. SITC 764.3 showed Hungary sloping from 0.74 in 1980 to 0.62 in 1984, while Bulgaria remained at a low level of import reliance, falling from 0.19 in 1980 to 0.13 in 1984. Poland showed a steady increase in this category, from 0.27 to 0.41.

Table 2.7

WESTERN IMPORT RELIANCE MEASURES FOR TELEPHONIC AND TELEGRAPHIC APPARATUS (SITC 764.1)[a]

Country	1980	1981	1982	1983	1984
Yugoslavia	0.90	0.81	0.90	0.87	0.77
Bulgaria	0.05	0.18	0.35	0.34	0.60
Czechoslovakia	0.08	0.09	0.14	0.07	0.08
GDR	0.00	0.03	0.00	0.15	0.00
Hungary	0.45	0.25	0.40	0.23	0.15
Poland	0.06	0.03	0.09	0.10	0.11
Rumania	0.03	0.03	0.00	0.00	0.03
USSR	0.04	0.06	0.06	0.08	0.08

SOURCE: UNECE, various years.

[a]Does not include Rumanian or Soviet exports, or exports from the FRG to the GDR.

Table 2.8

WESTERN IMPORT RELIANCE MEASURES FOR TELEVISION AND RADIOCOMMUNICATION TRANSMITTING APPARATUS (SITC 764.3)[a]

Country	1980	1981	1982	1983	1984
Yugoslavia	*1.00*	*1.00*	*1.00*	*1.00*	1.00
Bulgaria	0.19	0.16	0.15	0.19	0.13
Czechoslovakia	0.10	0.39	0.11	0.18	0.07
GDR	0.23	0.47	0.03	0.10	0.00
Hungary	0.74	0.82	0.71	0.52	0.62
Poland	0.27	0.28	0.30	0.29	0.41
Rumania	0.57	0.27	0.29	0.15	0.09
USSR	0.10	0.08	0.23	0.24	0.16

SOURCE: UNECE, various years.

[a]Does not include Rumanian or Soviet exports, or exports from the FRG to the GDR.

Table 2.9

WESTERN IMPORT RELIANCE MEASURES FOR TELECOMMUNICATIONS APPARATUS NOT OTHERWISE SPECIFIED (SITC 764.8)[a]

Country	1980[b]	1981	1982	1983	1984
Yugoslavia	—	1.00	0.90	0.80	1.00
Bulgaria	—	0.04	0.05	0.09	0.82
Czechoslovakia	—	0.03	0.04	0.07	0.34
GDR	—	0.05	0.01	0.02	0.18
Hungary	—	0.60	0.40	0.12	0.22
Poland	—	0.11	0.07	0.07	0.36
Rumania	—	0.32	0.18	0.24	0.38
USSR	0.08	0.03	0.02	0.03	0.03

SOURCE: UNECE, various years.

[a]Does not include Rumanian or Soviet exports, or exports from the FRG to the GDR.

[b]Exports reported only for Bulgaria.

The data on import reliance in these categories are more useful for indicating temporary shifts in purchasing strategies than for revealing long-term trends. The measures tend to be quite volatile, since, unlike the commodities examined above, East European imports in this area are often associated with a single large-scale project. These figures offer the most illumination when combined with additional information. For example, the large upswing in Bulgarian reliance can be attributed to the installation of new telephone switching equipment and a strategy to become a major supplier of telecommunications equipment to the rest of the CMEA.

The large and increasing measures of reliance on Western imports of telecommunications equipment suggest that more detailed analysis should be made of Western contributions to CMEA technological change. The data also bring out most clearly that NSWP states can vary considerably in the degree to which their development strategies require imports from, and technology contacts with, the West. This underscores the point that policy on Western export control will affect individual NSWP states differently and will depend on demand and development plans in each of them.

Microcircuitry

Data for SITC 776.4, electronic microcircuits, suffer from problems of measurement similar to those of the communications categories. Many countries report only at the three-digit level, which means that commodities relying on older technologies such as various forms of vacuum tubes are also included. The data for SITC 776.4, shown in Table 2.10, exhibit the same pattern of import reliance shown in the communications areas: the highest level for Yugoslavia, the next for Hungary, and low levels for the rest of the CMEA. Yugoslavia's relatively low import reliance measures may be due to a greater weight of purchases from newly industrializing countries. These fall outside the sample set of developed Western exporters and so are not reflected in the data.[8]

Again, the export of higher-capacity microcircuits is controlled by COCOM and would contribute to lower import reliance measures for the CMEA. Also, the need for more-advanced microcircuits is limited somewhat by a generally lower level of sophistication in computer design in the CMEA. However, it is clear that this chain of causality could run in either direction. The Soviet, and presumably some East

[8]Of course, even computer manufacturers in the developed West receive many of their microelectronic components from Malaysia, Taiwan, and other Asian producers.

Table 2.10

WESTERN IMPORT RELIANCE MEASURES FOR ELECTRONIC MICROCIRCUITS (SITC 776.4)[a]

Country	1980	1981	1982	1983	1984
Yugoslavia	0.58	0.41	0.66	0.65	0.64
Bulgaria	0.02	0.02	0.20	0.16	0.06
Czechoslovakia	0.02	0.01	0.05	0.07	0.02
GDR	0.02	0.07	0.03	0.01	0.01
Hungary	0.34	0.28	0.36	0.25	0.24
Poland	0.09	0.03	0.12	0.12	0.05
Rumania	0.13	0.06	0.05	0.12	0.04
USSR	0.01	0.03	0.28	0.43	0.04

SOURCE: UNECE, various years.

[a]Does not include Rumanian or Soviet exports, or exports from the FRG to the GDR.

European, microelectronic industries have taken a different approach to producing new vintages of microchips (Snell, 1986). Rather than relying upon ever more densely packed, higher-technology microcircuits, a strategy of bit-slicing has been used to increase sophistication in CMEA computer design. Therefore, the data may reflect, in part, differing derived demand for microcircuits based upon different design philosophies and the resulting conflict in technical standards.

It should also be noted that relatively low per-unit costs for this commodity group make these goods unlikely to show as a large import category by total value, and the flows are most difficult to track accurately at this scale.

Scientific Controlling, Photographic, Optical, and Timing Equipment

Finally, the U.N. data also include information on exports of SITC categories 87, 881, 884, and 885. These fall outside the narrowly defined category of machinery and transport equipment but contain many high-technology items. Unfortunately, they also contain some less-sophisticated goods, and the data for the four categories are reported only in the aggregate, not separately. The data are included in this study but cannot greatly aid the analysis because of their shortcomings. Nevertheless, the consistently high relative import reliance measures in the CMEA for these categories are interesting, given the disparate character of the goods included. It is especially interesting to note the small impact of including Soviet exports.

The data for this grouping are reported in Table 2.11. Yugoslavia shows consistent, high import reliance measures, while the measure for Hungary declines at a moderate rate. The measure for Bulgaria changes little, although the share of Soviet imports shows an implicit decline: The import reliance measure for 1980 is 0.44 [0.29], and that for 1983 is 0.41 [0.37]. The rest of the measures show little change, hovering between 0.20 and 0.30, with the exception of Rumania's drop into this range from its previous high measure. The results could be interpreted as suggesting a considerable, stable reliance on imports of Western instruments.

Table 2.11

WESTERN IMPORT RELIANCE MEASURES FOR SCIENTIFIC AND CONTROLLING INSTRUMENTS, OPTICAL GOODS, WATCHES, AND CLOCKS (SITC 87, 881, 884, 885)[a]

Country	1979	1979[b]	1980	1980[b]	1981[c]	1982	1983	1983[b]	1984
Yugoslavia	0.92	[0.88]	0.90	[0.86]	0.88	0.88	0.86	[0.84]	0.88
Bulgaria	0.30	[0.25]	0.44	[0.29]	0.47	0.39	0.41	[0.37]	0.44
Czechoslovakia	0.33	[0.31]	0.34	[0.31]	0.31	0.32	0.32	[0.31]	0.31
GDR	0.25	[0.23]	0.24	[0.19]	0.28	0.20	0.26	[0.25]	0.18
Hungary	0.50	[0.46]	0.53	[0.45]	0.52	0.50	0.43	[0.40]	0.46
Poland	0.41	[0.35]	0.39	[0.30]	0.23	0.28	0.32	[0.26]	0.28
Rumania	0.64	[0.57]	0.62	[0.54]	0.42	0.28	0.23	[0.20]	0.22
USSR	0.42	[0.42]	0.37	[0.37]	0.33	0.33	0.32	[0.32]	0.31

SOURCE: UNECE, various years.

[a]Does not include Rumanian or Soviet exports, or exports from the FRG to the GDR.

[b]Includes Soviet exports.

[c]Czechoslovak exports not reported in 1981.

III. OVERALL RELIANCE ON TECHNOLOGY IMPORTS FROM THE WEST

This section summarizes the findings for the commodity groups by extending the method employed in the previous discussion to illustrate overall reliance by individual CMEA countries on technology imports from the West. The discussion is limited to commodities in SITC 7, machinery and transport equipment; it does not include data on scientific controlling, photographic, optical, and timing equipment. The figures for 1980 are biased in the direction of greater reliance on imports from the West, since, as noted earlier, export data were not available for all commodities for all the CMEA countries.

SHARE OF TECHNOLOGY-SAMPLE GOODS IN TOTAL IMPORTS

Assessment of the economic impact of the technology-sample commodities on each East European country is beyond the scope of this study. Nevertheless, it is useful to indicate roughly the volume that these goods represent in the aggregate. Table 3.1 shows the annual share of the technology-sample commodities in the aggregate amount of SITC 7 goods imported from the West.

Table 3.1

SHARE OF TECHNOLOGY-SAMPLE IMPORTS IN TOTAL MACHINERY IMPORTS FROM THE WEST

(Percentage)

Country	1980	1981	1982	1983	1984
Yugoslavia	12.3	11.2	13.8	14.7	15.2
Bulgaria	10.2	11.9	17.4	22.8	19.4
Czechoslovakia	14.2	13.9	14.5	15.4	15.3
GDR[a]	14.6	15.1	15.8	14.9	10.7
Hungary	12.4	11.7	10.8	12.3	14.1
Poland	5.1	18.9	21.2	15.1	13.6
Rumania	22.0	17.3	9.4	17.5	10.2
USSR	20.7	16.2	13.9	16.6	16.1

SOURCE: UNECE, various years.

[a]Does not include exports from the FRG to the GDR.

The technology-sample commodities constitute an average of approximately 15 percent of the total. Their significance in terms of quantity has gradually grown during the period for all countries except the GDR (whose figures are problematic in the absence of FRG export data), Rumania, and the USSR. It may be argued that, given the nature of these goods, their significance for the economies of the CMEA is greater than the shares would suggest. The annual-share figures for Poland certainly suggest that in times of economic hardship these goods are less likely to be dispensed with than other machinery imports. This will be dealt with more fully below.

TRADE-WEIGHTED IMPORT RELIANCE MEASURES

The import reliance measures for the individual technology-sample commodities were aggregated into a single, trade-weighted import reliance measure for each country. This raises the standard problems of aggregation, especially when using intra-CMEA prices. In the absence of a more apposite weighting scheme, the measure assumes that price will equate to marginal benefit. A commodity with a high import reliance measure that is not costly per unit but is a critical, high-technology component for the final assembly of other goods, e.g., microelectronic circuitry, would tend to be discounted by this weighting. Nevertheless, the trade-weighted import reliance measure is the most convenient way to summarize in one statistic the difference between individual CMEA members and the change in overall technology import reliance during the five years of interest.

Table 3.2 lists the trade-weighted Western import reliance measures by year. Yugoslavia's overall measure of import reliance, not surprisingly, is the highest. It remained relatively steady, actually increasing somewhat by 1984. The 1983 measure indicates a slight increase in reliance upon Soviet deliveries. Poland, Rumania, and Hungary began the period with approximately equal overall measures but declined at varying rates. Hungary's measures declined gradually, whereas Poland's decline was a bit more exaggerated. The falloff in Rumania was drastic.

The figures for Czechoslovakia also show a decline during this period; those for the GDR are, again, problematic due to the omission of export data from the FRG, but they also indicate a gradual decline, although most of the loss appears in the measure for 1984.

Bulgaria is the odd man out. From the lowest overall reliance level in 1980, it moved to the highest in 1983 and 1984.

Table 3.2

TRADE-WEIGHTED WESTERN IMPORT RELIANCE MEASURES FOR ALL TECHNOLOGY-SAMPLE COMMODITIES[a]

Country	1980	1980[b]	1981	1982	1983	1983[b]	1984
Yugoslavia	0.77	[0.76]	0.84	0.84	0.78	[0.73]	0.82
Bulgaria	0.21	[0.17]	0.31	0.39	0.49	[0.39]	0.40
Czechoslovakia	0.35	[0.30]	0.28	0.28	0.24	[0.19]	0.23
GDR	0.27	[0.23]	0.25	0.24	0.26	[0.20]	0.12
Hungary	0.46	[0.43]	0.42	0.41	0.38	[0.31]	0.37
Poland	0.49	[0.41]	0.45	0.47	0.31	[0.25]	0.31
Rumania	0.47	[0.41]	0.30	0.13	0.19	[0.14]	0.12
USSR	0.38	NA	0.23	0.23	0.25	NA	0.19

SOURCE: UNECE, various years.

[a]Does not include Rumanian or Soviet exports, or exports from the FRG to the GDR.

[b]Includes Soviet exports.

Several hypotheses might be advanced to explain these observations. The general decline might be attributable to hard currency current-account problems coupled with the overall decline in Western lending to Eastern Europe in the wake of the Polish events and the world debt crisis. The test of this hypothesis would be to calculate import reliance measures for the post-1984 period, when these troubles eased somewhat. Both Western bank lending and Western exports to Eastern Europe increased in 1985 after several years of decline. The relative freedom of Bulgaria from these problems and its ability to maintain access to Western credits could partly explain its increasing import reliance measures during this period.

A second hypothesis is that the CMEA was becoming more self-reliant, better able to substitute domestically produced goods for Western technology imports. A third is that after the instructive experiences of Poland and Rumania,[1] the nature of technology transfer from West to East changed, with the East Europeans placing more emphasis on mechanisms other than direct purchase, such as disembodied technology transfers and co-production schemes with Western partners. Again, extending the previous exercise to later years when the data are forthcoming would allow more informed discussion of the weight to assign to these alternative hypotheses.

[1]While it is not clear that the strategy of increased technology imports *per se* actually played much of a role in the economic collapse of these countries, this nevertheless remains a common perception in the CMEA.

It is certain that both of the latter developments were occurring to some degree. The case of Bulgaria, however, suggests that these phenomena were not preponderant. Bulgaria has been striving to develop its industrial base, particularly in machine building, electronics, and communications, and the intersection of these sectors, robotics. The data indicate that in spite of any material assistance Bulgaria might have been able to draw upon from CMEA sources or from other avenues of technology transfer, a necessary component of its drive to upgrade industry has been increased reliance upon Western imports. Any attempt to generalize this conclusion would require further examination of the specifics of Bulgarian development and their applicability to the situation of other CMEA states.

TECHNOLOGY IMPORTS AND GENERAL RELIANCE ON WESTERN IMPORTS

Is the pattern of East European reliance on Western technology imports different from the general traffic in machinery and transport equipment? Do individual East European states rely more heavily on high-technology deliveries from the developed West than they do on Western imports in other areas of machine trade? The import reliance measures developed previously can shed some light on this question. There is no satisfactory and objective means of disaggregating trade statistics to separate trade according to the technological level of commodities. The taxonomy used in this study is at best an *ad hoc* classification based on available information and expediency. Various commodities incorporating advanced technologies have necessarily been excluded, but at least a first cut has been made.

The analysis has thus far avoided the use of import reliance measures as anything more than a device to provide an ordinal ranking to countries and commodity groups over time. In the following, a measure of reliance on high-technology imports will be divided by a measure of general Western machinery import reliance to yield a new measure, the ratio of import reliance, RIR. That is,

$$RIR_j = TIR_j \,/\, MIR_j \qquad (3.1)$$

where

RIR_j = the ratio of import reliance measures for CMEA country j
TIR_j = the Western technology import reliance measure of CMEA country j

MIR_j = the measure of reliance by CMEA country j on imports of other Western machinery in SITC 7

The general machinery reliance measure (MIR) is simply the ratio of the value of imports from the West of all machinery and transport equipment (SITC 7), minus the commodity groups previously identified as constituting the high-technology sample, to the value of total imports from both the West and the CMEA of SITC 7 goods each year:

$$MIR_j = \frac{\sum_{n=1}^{p} (Wm_n - \sum_{t=1}^{v} W_{tn})}{\left[\sum_{n=1}^{p} (Wm_n - \sum_{t=1}^{v} W_{tn}) + \sum_{\substack{i=1 \\ \text{where } i \neq j}}^{k} (Cm_i - \sum_{t=1}^{v} C_{ti})\right]} \quad (3.2)$$

where

MIR_j = reliance by CMEA country j on imports of all other Western machinery included in SITC 7

Wm_n = country j's imports of SITC 7 machinery from Western country n

W_{tn} = country j's imports of technology good t from Western country n

Cm_i = country j's imports of SITC 7 machinery from CMEA country i

C_{ti} = country j's imports of technology good t from CMEA country i

This general reliance measure is similar to the previous aggregate technology import reliance measures, deriving from the same sources and presumably subject to the same biases. However, in this case, the aggregation is a simple average, since resources were inadequate to provide a trade-weighting of reliance measures for all the categories of SITC 7.

To provide uniformity, the measure for aggregate high-technology import reliance (TIR) serving as the numerator in the ratio will not be the trade-weighted number used previously, but rather a simple ratio of the values of imports from the West of all commodities in the technology sample to the total of the technology sample commodities imported from both East and West:

$$TIR_j = \frac{\sum_{n=1}^{p} \sum_{t=1}^{v} W_{tn}}{\left(\sum_{n=1}^{p} \sum_{t=1}^{v} W_{tn} + \sum_{\substack{i=1 \\ \text{where } i \neq j}}^{k} \sum_{t=1}^{v} C_{ti} \right)} \qquad (3.3)$$

where

TIR_j = the Western technology import reliance measure of CMEA country j

W_{tn} = country j's imports of technology good t from Western country n

C_{ti} = country j's imports of good t from CMEA country i

The interpretation of the RIR statistic is simple. If the ratio of the high-technology to the general machinery import reliance measure is 1.00, it would indicate, at this level of refinement, that the import reliance for high technology was not more pronounced than the general reliance on engineering product imports. A ratio greater than 1.00 would suggest that there is greater reliance on the developed West for imports of the high-technology commodities considered in this study than for the general pattern of the visible trade in machinery. Alternatively, a measure of less than 1.00 would mean that there is relatively less reliance on the West in the technology commodity groups than in the other commodities in SITC 7.

The data in Table 3.3 indicate that Eastern Europe is generally more reliant on the developed West for higher-technology goods than for other types of machinery and equipment. Beyond that, because of various biases, inferences become speculative. Yugoslavia and Czechoslovakia show the least difference between patterns of trade in low- and middle-technology goods and imports of Western high technology. The figures for Czechoslovakia are just below, and those for Yugoslavia just above, the 1.00 mark for the entire period. In the Yugoslav case, the proximity to 1.00 is most likely due to a greater tendency to rely on the West for machinery imports generally, while for Czechoslovakia, it is due to a Western technology reliance measure that is comparatively low by CMEA standards.

The large discontinuity between the measures for 1980 and 1981 is partly due to incomplete data. It may also reflect the sharp change in East-West commercial relations following the Polish events of 1980 and the rescheduling of the Polish, Yugoslav, and Rumanian debts. For most countries, after 1980, the ratio holds relatively constant or

Table 3.3

RATIO OF AVERAGE WESTERN IMPORT RELIANCE MEASURES FOR ALL TECHNOLOGY-SAMPLE COMMODITIES TO AVERAGE WESTERN IMPORT RELIANCE MEASURES FOR ALL OTHER SITC 7 COMMODITIES[a]

Country	1980	1980[b]	1981	1982	1983	1983[b]	1984
Yugoslavia	1.11	[1.08]	1.02	1.08	1.02	[1.08]	1.08
Bulgaria	1.42	[1.12]	0.81	1.15	1.49	[2.38]	1.25
Czechoslovakia	1.54	[1.30]	0.98	0.91	0.96	[1.03]	0.99
GDR	2.07	[1.76]	1.06	1.04	1.02	[1.14]	0.74
Hungary	2.05	[1.88]	1.06	1.10	1.25	[1.49]	1.35
Poland	0.98	[0.79]	1.28	1.79	1.26	[1.39]	1.20
Rumania	1.45	[1.21]	0.84	0.48	0.90	[1.01]	0.55
USSR	1.54	NA	0.94	0.74	0.85	NA	0.80

SOURCE: UNECE, various years.
[a]Does not include Rumanian or Soviet exports, or exports from the FRG to the GDR.
[b]Includes Soviet exports.

increases over time.[2] In other words, beginning in 1981, the ratios of technology-sample commodities to the general pattern of machinery imports show an increasing differentiation in reliance. Trade with Western countries during the years of interest here was becoming more focused on the high-technology goods.

Two inferences may be drawn. They are not mutually exclusive, but both are inconclusive in the absence of further information. The first is that in the presence of hard currency constraints, the import strategies of Eastern Europe emphasized the priority of essential goods necessary for sustaining future growth that could not be obtained within CMEA. The available data are not in themselves sufficient to sustain this hypothesis, but they provide corroboration for work by Crane and Kohler (1985) that refutes the supposition that East European hard currency resource elasticities for machinery are high. These imports are not the first to be cut by the Soviet bloc countries when hard currency is scarce. With this interpretation, the data suggest that the higher the technological level of the machinery, the less elastic is the relative demand with respect to a hard currency budget constraint.

The second inference is that to the extent that indigenous CMEA substitutes for Western machinery imports have been developed, they have tended to be at the lower end of the technology continuum. The technology-sample commodities include items that have been the objects of major CMEA R&D efforts: machine tools, computers, communications technology, and microelectronics. It cannot be said that

[2]The GDR shows a large dip in 1984, but this is difficult to interpret due to the lack of data on inter-German trade.

the sample misses areas of primary focus for Soviet bloc development projects. The nondecreasing trend of the ratio of high-technology to general machinery import reliance could thus be ascribed to an increased ability in the CMEA to satisfy the lower end of the bloc's technology requirements, while not affecting a continuing reliance on the West for higher-end commodities.

The case of Poland is instructive. During the course of Poland's economic woes, the ratio of high-technology to general machinery import reliance changed from 0.98 [0.79] in 1980 to 1.28, 1.79, 1.26 [1.39], and 1.20 in 1981–1984. In other words, in a time of crisis, trade in most machinery categories was reoriented to the CMEA, but relatively less so in the technology-sample categories. As the immediate crisis passed, this difference became less pronounced. The figures suggest more prudent control over import priorities, assuming the efficient assimilation of technology inputs, than is usually ascribed to the Polish authorities. In Rumania, the opposite strategy was employed. The higher-technology commodities showed a relatively greater decline in reliance on imports from the West than did machinery in general.

The trends for Hungary and Bulgaria are similar to Poland's, increasing in differentiation, although the Bulgarian increase is more dramatic. The Hungarian gap widened steadily, from 1.06 in 1981 to 1.35 by 1984. The measure for Bulgaria was 0.81 in 1981, rising to 1.25 in 1984, with a peak of 1.49 in 1983. Based on the earlier discussion, the similar trends may stem from different proximate causes. In Bulgaria, the increase in the ratio is contemporaneous with an investment strategy emphasizing modernization of the machine-building and electronics (including telecommunications) sectors. If the data are accurate, they suggest that even after the examples of Poland and Rumania in the 1970s, large-scale programs of this type lead to increased reliance on technology imports from the West. This finding is striking in view of the differences in the level of development between Bulgaria and such countries as Czechoslovakia and East Germany, to whom, it might be expected, the Bulgarians would turn if the necessary advanced equipment were available within the CMEA. Western technology imports may be necessary to fill gaps in the CMEA supply or to provide crucial components necessary to increase the effectiveness of less-advanced CMEA equipment. As an extreme example, there are reports that the GDR now sells some industrial machinery with empty slots for electronic components that buyers must acquire elsewhere (Diehl, 1986). Less-dramatic specific dependencies must also exist.

The Bulgarian data reflect a period of increased deliveries from both the West and the CMEA of machinery and transport equipment, with

a relative increase in reliance on the West for high technology. The Hungarian ratio, on the other hand, increased during a period of slow growth and import cutbacks, affecting even machinery and transport equipment deliveries from the CMEA. The decrease in the latter might also have been due to pressure on Hungary to reduce its ruble current-account deficits. The results appear similar to the Bulgarian experience during a time of general import expansion. Such cuts or import controls as did exist appear to have favored relatively the import of Western technology goods. To the extent that there was substitution by CMEA sources for SITC 7 goods formerly imported from the West, this was disproportionately high in categories other than the high-technology sample group.

Finally, the data for 1983 allow the construction not only of the same ratios as for the other years, but also of analogs in which Soviet exports to Eastern Europe are factored in. In each case, the addition of Soviet export data causes the ratio indicating a difference in trade patterns between the technological and general engineering goods to increase. However, the data for the Soviet Union are not as complete as for other countries in the sample and do not include information on certain categories in the technology sample. To provide a more direct comparison, the ratio of high-technology sample to general machinery import reliance (RIR) was recalculated for each country, using 1983 data, but this time the numerator includes only the goods also reported for the Soviet Union—centrifuges, filtration apparatus, metal-working machine tools, and automatic data processing equipment (SITCs 743, 736, and 752). These categories represent 88 percent of the value of traded goods in the full technology sample. The ratios are shown in Table 3.4.

The more narrowly restricted results for 1983 again show an increase in differentiation of trade when the Soviet data are included. The differences are nominal for Yugoslavia, Czechoslovakia, and Rumania, slightly more substantial for the GDR and Poland, and pronounced for Hungary and Bulgaria.

In other words, for each country, the addition of Soviet machinery deliveries to the CMEA totals accentuates the difference in import reliance on the West for this sample of high-technology goods, compared with the general trade in machinery. Soviet deliveries to Eastern Europe are not weighted in the direction of goods included in the technology sample. The inference from this measure is that Eastern Europe tends to rely more on the West for the higher-technology goods included in the sample than for machinery imports in general, and more on the European CMEA than on the Soviet Union.

Table 3.4

RATIO OF AVERAGE WESTERN IMPORT RELIANCE MEASURES FOR SELECTED TECHNOLOGY-SAMPLE COMMODITIES TO AVERAGE WESTERN IMPORT RELIANCE MEASURES FOR ALL OTHER SITC 7 COMMODITIES, 1983[a]

Country	1983	1983[b]
Yugoslavia	1.00	[1.04]
Bulgaria	1.60	[2.50]
Czechoslovakia	1.07	[1.10]
GDR	1.24	[1.31]
Hungary	1.31	[1.53]
Poland	1.40	[1.49]
Rumania	1.00	[1.05]
USSR	0.97	NA

SOURCE: UNECE, various years.

[a]Does not include Rumanian or Soviet exports, or exports from the FRG to the GDR; selected sample includes SITC 736, 743, and 752.

[b]Includes Soviet exports.

THE ROLE OF THE WEST

This section concludes with a discussion of the other side of the coin: What is the stake of Western countries in maintaining deliveries of high-technology commodities to Eastern Europe and the Soviet Union? A major obstacle to developing a unified Western approach to technology transfer is the difference in the consequences of reduced trade for exporting states. In particular, the role played by the United States differs significantly from that played by several of its major allies.

In 1984, the latest year for which data are available, U.S. exports of high-technology goods to the CMEA were negligible compared with total U.S. exports. Deliveries of pumps, centrifuges, and filtration apparatus to the CMEA made up only 0.4 percent of total U.S. exports of these goods. Similarly, only 0.6 percent of all machine tools exported by the United States were shipped to Eastern Europe. And these were the highest percentages for the United States among the technology-sample commodities.

In contrast, West German sales of machine tools to the CMEA, not including deliveries to the GDR, accounted for 17.9 percent of over $2 billion in total machine-tool exports. Machine-tool sales to the East are not much less important in percentage terms (at least 10 percent of the total) for France, Italy, Switzerland, and Sweden, all major world suppliers. Austria and Finland each ship half of their exported machine tools to the CMEA.

These differences are less profound for other commodities, although there is still a potential for conflicting policy in some areas. For example, virtually none of the U.S. exports of automatic data processing equipment (0.07 percent) go to the CMEA. France, on the other hand, shipped 6.0 percent of over $1 billion in total foreign sales to the CMEA. Even in absolute terms, the difference is large.

If the values of all the commodities in the technology sample are totaled, for no CMEA country was the U.S. share of such imports from the West greater than 5 percent in 1984. The average was about half that. The same generally holds true for the individual categories of high-technology goods, with the exception of some communications categories. In SITC 764.3, the U.S. share was 22.5 percent of Bulgarian and 33.3 percent of Hungarian imports from the West in 1984. Similarly, in SITC 764.8, the figures for Bulgaria and Hungary were 34.8 percent and 21.1 percent, respectively. Even so, the U.S. share of total Western exports to the CMEA in these categories was 1.5 percent and 3.6 percent.

These figures suggest that the current low level of U.S. participation in high-technology exports to Eastern Europe places limits on the ability of the United States to use direct technology exports in pursuit of policy goals. It is possible that the goods actually delivered by the United States are of such a high technological level that the effect of cutbacks would be amplified to some extent. But no matter what the amplification factor, the small proportion of U.S. exports of these commodities means that East European dependence on them has to be fairly low. Unilateral influence can be obtained only by increasing sales of high-technology commodities to the CMEA as a *quid pro quo*, clearly a policy choice requiring the most careful consideration in relation to other policies touching the CMEA countries and to the national interest. Any U.S. action can be effective only as part of a multilateral effort. Policies suggesting the use of technology export restriction or expansion must clearly be coordinated with the other members of COCOM. Coordination is also needed with developed Western states that lie outside the COCOM apparatus, such as Sweden, Switzerland, Austria, and Finland. Attempts by the United States to expand the list of controlled commodities for the goods that are currently traded are almost certain to raise a reaction from Western allies who are more likely to be adversely affected than the United States. Policy choices directly affecting technology trade will most likely be focused on commodities that represent new technologies or new embodiments of older technologies that are not currently traded.

IV. THE ROLE OF MACHINE-TOOL IMPORTS IN HUNGARY: A CASE STUDY

There are several problems in translating technology import reliance into a meaningful measure of dependence on foreign technology. One is that the relative role of imports in domestic investment must be known. High reliance on Western imports means less if most of the demand is met by domestic production and total imports play a small role. A second problem is the difficulty of classifying imports by technological level. Even within a commodity group, it is difficult to assess the comparative technological level of individual goods imported from different areas. Though imports may fulfill only a small share of total demand for a capital good, the technological level of what is imported may be disproportionately high for the fraction imported from the West. Finally, there may be many reasons for importing a machine from the West rather than the CMEA—the lack of adequate substitutes may be only one of them. The favorable per-unit cost of a specific item, weighted by quality and other characteristics that might lead to a decision to import from the West under normal circumstances, would not preclude shifting reliance to CMEA substitutes should conditions warrant. In such cases, to speak of dependence is problematic at best.

As a step to coming to grips with some of these difficulties, this section illustrates the concept of import reliance with the specific experience of one CMEA country and one commodity. The findings, while not generalizable, help explore the connection between import reliance, as measured, and a fuller understanding of import dependence.

The case is that of machine tools in Hungary. Hungary was chosen because of the high quality and accessibility of data routinely published in its official statistical series. Machine tools are of interest because of the central position they hold in all CMEA development programs. They also represent the single largest group of technology imports from the West. Further, the difference in level of sophistication between traditional and numerical control (NC) machine tools is clear; technological taxonomy is certain at least to this level. The year analyzed is 1983, the latest year for which Soviet exports are reported in the U.N. data.

THE ROLE OF IMPORTS

In 1983, Hungary's Western import reliance measure for metal-working machine tools was 0.42 [0.36] (based on UNECE data). Published Hungarian data were used to calculate a similar ratio corresponding to this measure for the same year. Data were available on the importation of lathes, drilling machines, planing machines, grinding machines, and milling machines, denominated in forints. The ratio analogous to the import reliance measure for these machine-tool types is 0.34 [0.28].[1] The two sets of figures are not strictly comparable, since the five categories available for computation from Hungarian data do not represent the full range of machine-tool types falling under SITC 736, e.g., they do not include metal-forming machine tools and less common metal-cutting types. Many of these are specialized machines that adhere to higher technical specifications and therefore, presumably, are more readily obtainable in the West, barring export controls.

Domestic sales of "metal-working machine tools" amounted to Ft 2,952 million, while imports of "machine tools and other metal-working machines" amounted to Ft 2,602 million.[2] If the two categories are congruent, imports accounted for 47 percent of domestic absorption (i.e., domestic production, net of exports, plus imports) in Hungary in 1983. At this time, the country was going through a profound hard currency liquidity crisis and a general, centrally administered import and investment slowdown.

Table 4.1 gives some indication of the role Western machines played in the import totals. Disaggregated data were available only for the five machine-tool types shown. While Eastern Europe and the Soviet Union provided 83.1 percent of the machine tools imported, they accounted for only two-thirds of the total value of machine-tool imports. Western machines provided over one-quarter of the total value but only 6.1 percent of individual units. In view of the share of total imports in machine-tool investment, this means that in value terms, one of every eight machine tools emplaced in Hungary in 1983 was imported from the developed West.

The Western machines are clearly more expensive on a per-unit basis than the imported CMEA machines. It is presumed that a portion of these machines embody higher technology than their CMEA counterparts. Reliance on Western machine tools also varies with

[1]All data in this section, unless otherwise stated, are from *Statisztikai Evkonyv*, *Iparstatisztikai Evkonyv*, and *Kulkereskedelmi Evkonyv*, 1983.

[2]Since exports were reported as Ft 3,905 million in 1983, the figure for domestic sales must apply only to domestically produced machines.

Table 4.1

MACHINE-TOOL IMPORTS TO HUNGARY IN 1983 BY AREA OF ORIGIN, AS A PERCENTAGE OF TOTAL IMPORTS OF EACH TYPE

Origin	Lathes	Drilling Machines	Milling Machines	Planing Machines	Grinding Machines	Total
CMEA Six						
Number	66.9	45.5	56.3	17.6	60.0	54.6
Value	62.0	52.1	52.6	7.5	41.7	51.0
CMEA Six and USSR						
Number	85.5	93.7	78.8	57.1	69.6	83.1
Value	78.2	81.8	67.8	46.5	51.4	67.8
Developed West						
Number	3.1	1.8	5.1	2.2	21.5	6.1
Value	15.6	16.8	27.4	36.6	41.6	26.3
Total[a]						
Number	88.6	95.5	83.9	59.3	91.1	89.2
Value	93.8	98.6	95.2	83.1	93.0	94.1

[a]The columns do not total to 100.0 because imports are also received from countries not included in this study.

type. Machine tools with more sophisticated functions, such as grinders and milling machines that operate on multiple axes, tend to be overrepresented by Western imports relative to the average.

RELATIVE TECHNOLOGICAL LEVELS OF IMPORTS

The trade in NC machine tools provides a better sense of the qualitative difference between CMEA and Western machine-tool imports to Hungary. NC tools are a subset of the total machine-tool trade. They represent a higher technological standard, since they incorporate some type of digitalized, programmable control system, usually in the form of integrated microprocessors.

According to information obtained from a voluntary association of most of the NC machine-tool-using enterprises in Hungary, the *Szerszamgep Programazasi Egyesules* (SPE),[3] a total of Ft 406.3 million worth of imported NC machines was emplaced by their members in 1983. Of this total, Ft 357.5 million—88 percent by value—came from the West (SPE, various years). These figures for imports from both the CMEA (including the Soviet Union) and the West can be used to construct ratios in which the numerators are the value of NC machine-

[3]The Machine Tool Programming Association.

tool imports from the appropriate area, the CMEA or the West, and the denominators are the respective total import values from each area of the five machine-tool types, both NC and traditional, discussed above. This yields a proportion of 0.05 for Hungarian machine-tool imports from the rest of the CMEA and 0.96 for machine-tool imports from the West. This is not to say that only 5 percent of machine-tool imports from the CMEA and 96 percent from the West are of the NC variety; in the absence of more concrete data, it must be assumed that the denominator is more narrowly defined in this case than the numerator. However, it can be inferred that the preponderance of machine-tool imports from the West are of the NC type, while CMEA machines at this end of the technology spectrum are a small fraction of total CMEA deliveries.

The SPE data for NC machines acquired by its members in 1983 show a total of Ft 157.4 million of Hungarian manufacture. Alternatively, the *Iparstatisztikai Evkonyv* (1983) gives figures for production, net of exports, of NC drilling-milling machines, production centers, lathes, console milling machines, and grinders totaling Ft 425.2 million. If the latter figure is accepted as representing the domestic contribution to fulfilling the demand for NC machine tools and it is assumed that all Hungarian NC imports are accounted for in the SPE listing, then imports accounted for 49 percent of absorption. Given the conservative nature of the assumptions, the true figure is likely to be higher. Even so, these figures imply a 43 percent share for Western imports in the total of NC machine-tool investment in 1983, a year of general retrenchment in Hungarian industry.

The flows for 1983 are corroborated by the data on the stocks of Hungarian NC machine tools reflected in the SPE listings through the first quarter of 1984. Western NC machines accounted for 41 percent of the value of the stock of NC lathes (19 percent of the total number of such units), 56 percent (31 percent) of NC milling machines, 74 percent (56 percent) of NC drilling machines, and 79 percent (57 percent) of all other NC types listed by the SPE. Further analysis would be needed to determine the trend for marginal additions to the existing stock of NC equipment.

Western machines make up a large share of the NC machine-tool stock. Available data shed some light on the role played by these machines. The calculated per-unit costs of Western NC machines is generally more than double the weighted average of domestic and other CMEA costs for each type. A calculation of the coefficient of varia-

tion[4] of implied prices for each of these NC machine types is presented in Table 4.2.

The data show a uniformly greater dispersion of prices for Western NC machine tools. Since these statistics are derived from stock rather than flow data, part of the difference in coefficients of variation may be attributable to a greater tendency for inflation to affect Western machinery prices over time than is true for CMEA machines.[5] However, the coefficients may imply that Western imports play a different role in Hungarian development schemes than do either domestic or other CMEA equipment. The greater dispersion of prices could be caused by a wider variation in the characteristics of the machines imported. While Hungary and the CMEA may concentrate on producing relatively few machine types that take care of the bulk of machining jobs, Western machines may be acquired along a wider range to fill the gaps left by the absence of particular machine types in CMEA output. In this sense, the addition of a few Western NC machines not otherwise available within the CMEA may be required to complete an enterprise's complement of machine tools and render the whole, including the CMEA machines, more effective. Further, it may be supposed that machines acquired to occupy the niche at the higher end of the technological sophistication and performance spectrum may be disproportionately Western and therefore considerably more expensive than even the Western mean. This too would lead to a greater dispersion, as well as greater skewedness, in the prices of Western machine tools. If these suppositions are true, reliance in this sense may bespeak a large degree of dependence: Substitutes may not presently exist within

Table 4.2

COEFFICIENTS OF VARIATION OF NC MACHINE-TOOL PRICES BY TYPE AND ORIGIN

Origin	Lathes	Drilling Machines	Milling Machines	Other
Hungary	0.39	0.53	0.39	0.34
Other CMEA	0.40	0.22	0.40	0.09
West	1.37	1.14	1.67	0.57

SOURCE: SPE data.

[4]The standard deviation divided by the mean, a measure of central tendency.

[5]The official price index on total machinery investment indicates that prices for domestic machinery increased 19 percent between 1975 and 1983, while imported-machinery prices increased by 27 percent (*Statisztikai Evkonyv*, 1983).

the CMEA for some fraction of the NC machine tools imported from the West.

THE DECISION TO IMPORT FROM THE WEST

As noted earlier, the importing of Western technology by an East European country does not *ipso facto* provide a strong case for the existence of a relationship of dependency. In part, a concept of dependence must be concerned with the available recourse if existing East-West commodity flows were to be halted. In the case of Hungary, enterprises themselves are responsible for investment decisions, and, more than elsewhere in the CMEA, managers are conscious of and motivated by costs. It may be, therefore, that the actual flow of Western NC machinery is determined by the relative cost of equipment. It is not inconceivable that given the choice between comparable Western and CMEA NC machine tools, a prudent manager would consider the technical characteristics of the equipment in relation to price and decide to import from the West, having determined that this would be the most efficient way to use the available funds. The outcome of this decision might be different if prices changed in favor of the CMEA machine. Faced with export controls or other barriers to Western imports, the manager may shrug his shoulders and purchase the CMEA equipment; the decision is made for him. Certainly, a concept of vulnerability would not apply in such an instance. This raises the question of whether NC machines are purchased from the West because such imports have a very low elasticity of substitution with respect to their CMEA alternatives, or because the relative costs of the alternatives make importing from the West expedient and efficient.

While this discussion cannot hope to resolve the question, the data from the SPE listings can at least provide a better sense of the role of relative prices in the import decision. In particular, how elastic is the demand for Western NC imports? Previously, it was hypothesized that Western NC machine tools may serve a different purpose and fill niches not covered by CMEA machines. To explore this point further, Eq. (4.1) serves as a simple model of the import decision faced by Hungarian enterprise managers. Expenditures on Western NC equipment depend on a budget constraint and a ratio of Western to CMEA machine prices. Price data from 1972 to 1983 were used to run the regression detailed in Eq. (4.1):[6]

[6]The form is similar to that used by Houthakker (1965) in his studies of demand elasticities.

$$\text{LNWEST} = -3.2831 + \underset{(0.1516)}{1.2253}\ \text{LNTOTAL} + \underset{(0.2320)}{0.6219}\ \text{LNPRAT} - \underset{(0.0484)}{0.1287}\ \text{T}$$

R squared = 0.97 DF = 8 n = 12 (4.1)

The logarithm of the total expenditure on Western NC machine-tool imports by year (LNWEST) for 1972 to 1983 was regressed on the logarithm of total expenditure for NC machine-tool acquisitions from all sources (LNTOTAL), the logarithm of the annual ratio of average Western NC prices to a weighted average of Hungarian and other CMEA NC machinery prices (LNPRAT) and a linear time trend (T). The current values for LNWEST and LNTOTAL were deflated by the official indices of non-Socialist imported machinery investment prices and of total machinery investment prices, respectively (*Statisztikai Evkonyv*, various years). The numbers in parentheses are standard errors; all coefficients are significant to the 0.98 level.

The estimated coefficient of the LNTOTAL term, expenditure on all NC machine tools acquired in a given year, has the expected sign if the variable is interpreted as a measure of available investment resources. The size of the coefficient indicates that the demand for Western NC imports is elastic with respect to a budget constraint. This interpretation is not fully satisfactory, since the assumption of independence for LNTOTAL in this functional form is problematic and no account is taken of hard currency constraints or of notional demand left unexpressed due to import and export controls of various kinds, but the result accords with intuition.

The coefficient of the price ratio appears perverse: It suggests that the greater the price ratio, the greater is the desire for Western imports.[7] It should be remembered that the Hungarian enterprise manager, more than managers in any other East European country, makes the acquisition decision based on domestic (forint) prices that reflect accurately the unsubsidized import cost of Western capital, pays import duties on top of the basic price, and is supposed to work within an enterprise budget.[8] Two interpretations can be offered in explana-

[7]If the regression is run without inclusion of the time trend (T), the coefficient on the relative price variable is still positive, although no longer significant. The time trend was included to provide a proxy for changes during the period that would otherwise call the assumption of *ceteris paribus* into serious question. The linear time trend in the model is a simple specification, although it probably reflects well the accumulating experience with NC technology and a growing intra- and extra-enterprise infrastructure that would tend to alter the demand for Western NC technology.

[8]This oversimplifies the case. The import decision is not solely up to the enterprise. An actual allocation of hard currency must be made by central authorities, and import permits must be obtained. Further, the enterprise budget constraint has been subject to some manipulation throughout the period discussed.

tion. First, there may, in fact, be dependence on the West for machine types not available in CMEA. The higher price may reflect a higher technical standard. A certain number of the machines are vital to the proper performance of individual Hungarian machine shops, i.e., are relatively noncompressible, so their higher price would naturally be reflected in higher expenditures.

A second, and more likely, explanation focuses upon qualitative differences: Per-unit prices of Western machines may be increasing in real terms relative to those of CMEA machines but actually *decreasing* if weighted by qualitative differences. The relative index of quality may be changing more rapidly in favor of the West. The decade of the 1970s was precisely the period when the earlier form of NC technology using relatively simple digital decoders and punched-paper programs was giving way to the more sophisticated forms of internal microelectronic circuitry embodied in direct NC (DNC) and computer NC (CNC) equipment. These qualitative changes were incorporated much more rapidly in Western equipment than in CMEA equipment, even equipment constructed on the basis of license purchases from the West. This leads to the hypothesis that much of the imported Western equipment was of an altogether different technological type than that produced and available for trade within the CMEA. If so, considering the central role of NC machine tools in East European development schemes, this would strengthen the case for interpreting reliance as an indication that Western imports are fulfilling a need not easily met by CMEA sources.

CONCLUSIONS

The results of this case study corroborate the inferences suggested by the simple Western import reliance measure. The evidence supports the results of the earlier analysis by identifying machine tools as an important high-technology import from the West. The level of imports is approximately on the order suggested by the import reliance measure. Further disaggregation into traditional and NC machine tools shows that as the technological character of the machine tools increases, reliance on Western imports becomes greater, in spite of the fact that the production of high-quality, automated machine tools has been a priority within the CMEA. The central importance of these commodities and the large share that imports from the West provide to this crucial capital stock reinforce the view that the short-term possibilities for economic growth and development in Hungary would be seriously compromised by their absence. Imported Western NC machines in particular tend to be more necessary than expedient.

V. CONCLUSIONS AND IMPLICATIONS FOR POLICY

The calculation of Western import reliance measures for each NSWP country by discrete technology commodity groups is a useful, if inconclusive, exercise in establishing the degree of potential dependence on Western technology imports. It indicates that there is a good deal of variation in the degree of import reliance between the countries of Eastern Europe and among technology groups. To think of the phenomenon of technology transfer only in terms of the more aggregate categories of "Eastern Europe" and "high technology" is to miss most of this variation.

Variability in the volume of technology imports from the West stems from differences in domestic economic cycles, the status of international trade and payments, relations with the West, and fundamental political choices. The last of these is strongly subject to influence by the policy choices made by the West, on the one hand, and the Soviet Union, on the other.

The data used in this study are not adequate to answer conclusively the questions of whether the technological level of Eastern Europe as a whole is rising or whether an individual country's degree of import reliance changes with rising technological level. The import reliance measures of technologically advanced East Germany and Czechoslovakia are relatively low, but these results may be anomalous. The East German measures are calculated without data on the massive flow of technology from the FRG, which goes unreported. Czechoslovakia's case seems dominated by political choices that have also contributed to a decline in the country's technology base.

The Bulgarian experience is that of a less-developed country attempting to rapidly change its technology base. Bulgarian reliance on Western technology imports is thus relatively heavy. Coupled with the findings on the role played by Western machine-tool imports in Hungary, the Bulgarian case suggests that it is not yet possible for an East European nation to forgo imports of technology from the West when modernizing the base of its industry.

While the sophistication of goods produced within the CMEA will continue to increase, the recently announced major program for increasing R&D cooperation and integration is not likely to have a pronounced positive effect on the ability to substitute for Western imports. The practical problems besetting this program are many and

are compounded by attendant political problems. The political problems are likely to be exacerbated as long as Eastern Europe continues to view the West as a viable source for needed technology. No immediate upsurge in the ability of the CMEA to provide for its own technology needs should be expected as a result of this effort. Longer-term effects will depend on the occurrence of fundamental changes in the CMEA.

This study is too limited in scope to suggest directions for Western policy relating to technology transfer, but it does set out in sharper relief certain factors that necessarily bound the range of policy choices.

First, the ability of the United States to form meaningful policy independent of other developed Western exporters is limited by the fact that the United States accounts for only a small share of Western sales to the CMEA. This also complicates the fashioning of collective policies on denial of specific dual-use technologies, since the domestic consequences of such policies usually have a greater effect on other members of COCOM than on the United States.

Second, the rapidity of technological change in the developed West and the diffusion to the developing nations of the ability to manufacture high-technology components will undermine the power of the United States and other developed Western nations to monitor and control technology flows to the CMEA. While much of this diffusion takes place under the auspices of Western multinational corporations which theoretically can be made to conform to guidelines on technology export, the enforcement problem becomes more difficult as the number of players in the game increases.

This is certainly not to suggest that the policy of control should be abandoned or that a policy of deliberately increasing high-technology commodity trade with the CMEA should replace it as a means for increasing Western influence. For one thing, the countries of the region are becoming increasingly sophisticated about their ability to sustain sizable imports of technology based upon the ability to earn hard currency. This has led to policy changes in Eastern Europe that will naturally have an effect on demand. In the future, there will be increased emphasis on alternative means for obtaining Western technology, such as cooperation agreements, licensing, joint production, and other forms of disembodied transfer. Moreover, there is continuing legitimate concern for collective Western security with regard to the transfer of militarily useful technology.

On the other hand, policies of denial should not be predicated on the simple syllogism that the transfer of technology necessarily means handing over to the existing regimes a panacea for all internal contradictions of development. While the term *technology* must be decom-

posed by commodity, if one is to speak accurately, the experience of the 1970s and 1980s is that technology has flowed, yet profound economic problems remain. A distinction should be made between gaps in the technological levels of East and West that are due to differential access to leading-edge technologies and gaps caused by a relative inability or lag in applying those technologies that are made available to all. Acquisition and implementation are two different issues.

Technology transfer itself is disruptive. It rarely resembles the simplified process portrayed in economic theory. In many instances, when technology developed in one country is transferred to another—even another at the same technological level—the results are not immediately satisfactory, and the transfer reveals unsuspected problems of organization and management.

This leads to a third point, which would require further work to verify but is worth raising here. Although the original intent of importing Western technology was to provide quick fixes for the economies of Eastern Europe in lieu of systemic reform, specific and general instances of problems with absorption and effective utilization may lead to a widening perception in the importing nations that reform is imperative. In other words, when advanced machinery of a known productive capacity fails to live up to expectations in its new environment, the rigidities within the enterprise, the sector, and the surrounding economic milieu are called into question.[1] It may well be that by acquiring the technology from the West rather than developing it domestically, the East Europeans are multiplying this effect. The imported technology tends to be more revolutionary, not evolved from familiar expertise and industrial relationships, and is thus more jarring. If decentralization of the economic systems in Eastern Europe is viewed as a desirable object of policy by the West, a more sophisticated view of technology transfer as a means to that end might be warranted.

Finally, a search for a more active role for technology in serving Western policy ends need not necessarily require any change in current policies on export controls. East Europeans at the level of enterprise and industrial-sector management generally believe that COCOM is more broadly focused and active than it actually is. Much Western technology that is of great use to East European industry is continuously flowing from West to East. Western policy should explicitly emphasize at various levels of East-West contacts the true porousness of the technology embargo bogey that has been raised by the Soviet

[1]The new technology need not, in fact, be very highly advanced to elicit this effect. Simply being "foreign," that is, of a type different from what has previously been used in a given enterprise setting, may be quite sufficient for the technology to induce reappraisals of existing management systems (see Popper, 1985).

Union. To the extent that there is a general policy purpose to be served in demonstrating a commonality of interests between the West and Eastern Europe, the current flow of high-technology commodities is a highly tangible manifestation of that connection.

Appendix

DATA ON IMPORT RELIANCE

COMMODITIES IN THE TECHNOLOGY SAMPLE

Three criteria were employed in choosing the categories for calculating Western import reliance measures. The first was availability and comparability of data. As a practical matter, this reduced the choice to those categories reported in the UNECE publications. The second was a largely *ad hoc* judgment that the commodity group should represent a set of goods that might be considered to possess higher technological characteristics than those in other SITC categories. All the goods constituting the technology sample for this study appear on the list of high-technology commodities developed by the U.S. Department of Commerce (Lenz and Stiltner, 1985). The third criterion was that the category be sufficiently disaggregated at either the three- or four-digit SITC level to provide reasonable assurance that the bulk of the commodities were truly the types of interest.

The goods making up the technology sample were pumps for nonliquids, centrifuges, filtration apparatus, and compressors (SITC 743); metal-working machine tools as a group and disaggregated into metal-cutting and metal-forming machine tools (SITCs 736, 736.1, 736.2); automatic data processing and data reading equipment (SITC 752); telephonic and telegraphic communications equipment (SITC 764.1); television, radio, and radiotelegraphic transmitters (SITC 764.3); other telecommunication equipment (SITC 764.8); and microcircuits (SITC 776.4). A heterogeneous category of scientific and controlling apparatus (SITC 87), photographic apparatus (SITC 881), optical equipment (SITC 884), and watches and clocks (SITC 885) was studied but was not included in the technology sample.

COUNTRY DATA

All measures of reliance on Western imports were constructed by aggregating mirror export data for seventeen developed Western countries and dividing by total imports from those countries and from the European CMEA countries. The Western countries included in the sample were Austria, Belgium-Luxembourg, Canada, Denmark,

Finland, France, West Germany (the FRG), Ireland, Italy, Japan, the Netherlands, Norway, Spain, Sweden, Switzerland, the United Kingdom, and the United States.[1]

A major lacuna in the Western data is that the FRG does not report exports to the GDR, since this is not officially considered to be foreign trade.

The denominator included all imports from the developed Western countries listed above,[2] plus imports from those CMEA countries that were reported in the UNECE listings, i.e., Bulgaria, Czechoslovakia, the GDR, Hungary, and Poland. Imports from the Soviet Union were reported only in 1980 and 1983; a second import reliance measure was developed for those years by incorporating Soviet deliveries in the *denominator*. In general, the differences between the two measures were not as great as might have been expected. No Rumanian figures were reported for 1980–1984. In 1976, the last year Rumanian data were reported in the UNECE reports, Rumanian exports were 4.2 percent of the total of intra-CMEA trade in the commodities of SITC 7, machinery and transportation equipment, and 8.2 percent of trade within the East European CMEA. It may be presumed that Rumania's share in high-technology trade was somewhat less.

THE DATA SOURCE

All of the trade data used to calculate the Western import reliance ratios came from annual UNECE publications. This unified source imposed some regularity on the form of reporting, making it possible to construct individual import totals from mirror export data of many countries. This reduced the effect of idiosyncratic reporting by any one

[1]The sample originally included Brazil, Australia, Greece, and Portugal, but these countries were dropped due to the virtual absence of exports from them to Eastern Europe in the categories of interest. The UNECE trade volume compilations did not indicate that any major Western exporter of SITC 7 goods to CMEA has been excluded in this study.

[2]In theory, we would want the denominator to include imports from all sources. The problems of including all of them are practical rather than theoretical. Since the method consists of compiling aggregate import figures from mirror export statistics, to include all countries would greatly increase the data collection effort. Based on the data available in the UNECE database, this exclusion has little effect on the findings. The direction of any resulting bias to the import reliance measures should be downward. A second problem is that only major exporting countries are included in the UNECE data. To include such sources as Taiwan, South Korea, and Singapore would require going to other sources and thereby raising problems of nonisomorphic data. Again, the inclusion of this subset of potential exporters would not vitiate the study's findings on revealed reliance, but it would suggest a different relative importance for exports that originated outside COCOM.

country. Further, given limitations on resources for this study, the use of such a databank was the only feasible way to gather the data required. A full study along these lines would require the use of several data sources rectified against each other and corrected for known biases. The present approach is less conclusive but is still of value. The inherent conservatism of trade statisticians regarding changes in assumptions and definitions allows comparison between years. This relative stability improves the acceptability of the import reliance calculation as a relative measure.

Shortcomings stemming from the use of the UNECE data are of two types. The first is in the nature of the reporting. Western data are reported directly to the UN Statistical Office, and the UNECE data derive from that source. A major problem is caused by the omission of West German deliveries to the GDR.

The UNECE secretariat receives data directly from the countries of the CMEA. These data are originally submitted either directly in U.S. dollars or in national currencies that are then converted into dollars at the official rate. For some countries, the original data must be restated in terms of the commodity groupings of SITC revision 2 to be comparable. Therefore, a series of judgments, not explicitly treated, is made to include the CMEA data in the unified listings.

The greater problem is that of valuation. All data are reported in millions of current U.S. dollars, f.o.b. One major difficulty is the volatility of dollar exchange rates, especially in recent years. This problem, while perplexing, is not as great as it might have been. The dollar was most volatile in 1984–1987; only the last two years of the 1980–1984 period experienced dramatic changes. Further, direct exports of technology goods by the United States to the countries of Eastern Europe constitute only a small fraction of total Western exports. Therefore, most of the Western exports were originally stated in currencies that moved roughly in the same direction with respect to the dollar.

The problem is more serious in the case of CMEA data. Some currencies, such as the Hungarian forint and the Polish zloty, also moved at approximately the same rate as Western currencies in relation to the dollar. For others (the GDR, Czechoslovakia, Bulgaria, and the Soviet Union—Rumania represents a mixed case), official exchange rates were relatively fixed and, as is well known, unresponsive to real influences and even divorced from a need for internal or cross-national consistency. Further, while policies in the CMEA mean that the prices for homogeneous goods and raw materials approximate (with a lag) world market prices, machinery prices within the CMEA are notoriously subject to manipulation, making assessments of true relative worth problematic. The main shortcoming in using the UNECE

data is that the assumptions made in aggregation by UNECE are necessarily unobservable. Circumstances require accepting the unmodified figures as presented by UNECE, while noting the shortcomings and suggesting the direction of possible sources of bias.

SYSTEMATIC BIASES IN THE IMPORT RELIANCE MEASURES

The import reliance measures would be affected if there were significant exclusions in the reporting of exports by CMEA countries. The implicit assumption of the measure is that if exports are reported for a category of goods, they represent the total of all such exports. It is further assumed that export totals represent goods actually exported, not those scheduled for delivery, and that deliveries of military or other goods are not masked by inflating the totals of some commodity groups.

Systematic downward biases in the import reliance measures would stem from rigidities in foreign exchange adjustments by CMEA countries in a period when the dollar numeraire was appreciating. This would tend to overvalue CMEA exports in dollar terms. Further, it is generally accepted that due to the institutions of CMEA trade, the prices of East European machinery are inflated somewhat in comparison with world prices for machine types with similar characteristics. The size and scope of this overstatement is subject to debate. The net effect would be a downward bias in import reliance measures. This could be offset by a compensating bias if inflation in the prices of Western machinery proceeded more rapidly than price increases in their CMEA counterparts. It is not clear that this happened, however, during the period in question.

Finally, it should be noted that the data used to calculate import reliance do not reflect exports by countries not enumerated above, such as the industrializing nations of Asia; covert or illegal acquisition of high-technology capital goods; or the reexport of goods from the original destination to another country.

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